Foreword

This document was prepared under the sponsorship of several programs in the EPA Office of Water primarily to document the water quality benefits associated with the more than 16,000 publicly owned treatment works (POTWs) across the country. It emphasizes the role of the Construction Grants Program, which provided $61.1 billion in federal grants to local authorities from 1972 through 1995 to help support the planning, design, and construction of POTWs to meet the minimum treatment technology requirements established by the secondary treatment regulations or water quality standards (where applicable). The program has also provided more than $16 billion under the Clean Water State Revolving Fund (CWSRF) Loan Programs as capitalization grants to the states since 1988 to support a wide range of water quality improvement projects. The document was subjected to a formal peer review process that included detailed reviews and input from NOAA, USGS, AMSA, NRDC, NRC/NAS, NWRI, University of North Carolina, Johns Hopkins University, University of Alabama, states, consultants, local authorities, and others.

The document contains an executive summary and 13 chapters, including a background chapter, and chapters addressing BOD loadings before and after the Clean Water Act, the "worst case" dissolved oxygen (DO) levels in waterways downstream of point sources before and after the CWA, and nine case study assessments of water quality changes associated with POTW discharges.

The report presents the results of a unique, three-way approach for addressing such frequently asked questions as:

1. Has the CWA regulation of POTW discharges been a success?
2. How does the Nation's water quality before the 1972 FWPCA Amendments compare with the water quality conditions after secondary and better treatment was implemented?
3. Has the reduction of biochemical oxygen demand (BOD) loadings to surface waters from POTWs resulted in improved water quality in the Nation's waterways? If so, to what extent?

By examining the numbers and characteristics of POTWs, their populations served, and BOD loadings on a nationwide basis *before* and *after* the CWA, we were able to document changes in the number of people served by POTWs and the level of treatment provided, the amount of BOD discharged to the Nation's waterways, and the aggregate BOD removal efficiencies of the POTWs, while providing insight into the likely impact of future discharges if treatment efficiencies aren't improved to accommodate economic growth and expansions in service population.

We examined the "worst case" historical DO levels in waterways located downstream of point sources *before* and *after* the CWA in a systematic manner. By identifying water quality station records that related to the water quality impact of point source discharges from the "noise" of millions of historical records archived in STORET, and using DO as our indicator of water quality responses to long-term changes in BOD loadings from POTWs, we evaluated changes in DO for only those stations on receiving waters affected by point sources over time under comparable worst-case low-flow conditions (during July-September in 1961-1965 for before CWA and 1986-1990 for after CWA) using only surface (within 2 meters of the surface) DO data. We documented significant improvements in worst-case summer DO conditions at three different spatial scales, in two-thirds of the reaches, catalog units and major river basins.

Case study assessments were also completed on nine urban waterways with historically documented water pollution problems. These case study sites included the Connecticut River, Hudson-Raritan Estuary, Delaware Estuary, Potomac Estuary, James Estuary, Chattahoochee River, Ohio River, Upper Mississippi River, and Willamette River. Most of the these waterways were sites of interstate enforcement cases from 1957 to 1972, were listed as potential waterways for which state-federal enforcement conferences were convened in 1963, or were the subjects of water quality evaluation reports prepared for the National Commission on Water Quality. Two sites were on a 1970 list of the top 10 most polluted rivers. The case study sites did not include, however, any of the 25 river reaches with the greatest before versus after CWA improvements in DO found in our study. The case studies characterized long-term trends in population, point source loadings, ambient water quality, environmental resources, and recreational uses. Validated water quality models for the Delaware, Potomac, and James estuaries and the Upper Mississippi River were used to quantify water quality improvements achieved by upgrading POTWs to secondary and higher levels of treatment. The case study assessments document that tremendous progress has been made in improving water quality, restoring valuable fisheries and other biological resources, and creating extensive recreational opportunities (angling, hunting, boating, bird-watching, etc.) in all nine case study sites. At many of the sites there have been significant increases in species diversity and abundance—returned or enhanced populations of valuable gamefish (e.g., bass, bluegill, catfish, perch, crappies, sturgeon, etc.) and migratory fish populations, waterfowl and fish-eating bird populations, opened shellfish beds and more. Some of the sites have seen a return of abundant mayflies and other pollution-sensitive species, as well as dramatic increases in recreational boating and fishing. Water quality improvements associated with BOD, suspended solids, coliform bacteria, heavy metals, nutrients, and algal biomass have been linked to reductions in municipal and industrial point source loads for many of the case studies.

The unique, three-way approach undertaken by this study quantitatively supports the hypothesis that the 1972 CWA's regulation of wastewater treatment processes at POTWs has achieved significant success—success in terms of reduction of effluent BOD from POTWs, worst-case (summertime, low-flow) DO improvement in waterways, and overall water quality improvements in urban case study areas with historically documented water pollution problems. However, the study also points out that without continued investments and improvements in our wastewater treatment infrastructure, future population growth will erode away many of the CWA achievements in effluent loading reduction.

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